OPERATING INSTRUCTIONS

MODEL TTS 38 SERIES NOISE, LEVEL, VU AND PULSE MEASURING SETS

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MODEL TTS 38BS, TTS 38BDS-8, TTS 39BDS-9

NOISE, LEVEL, VU AND PULSE MEASURING SETS

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Manufacturers Code Letters for Table of Replaceable Parts

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VU-DB
DBRN
FILTER
HIGH PASS
3KC
C MSG
15KC
DBRN—VU—DBM
MON
310
CAL
PPS
CAL
%BK
INPUT
N—GND
900Ω
TERM
BRDG
TERM
BRDG
600Ω
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
PPS
% BREAK
FUNCTION
DBRN—VU—DBM
PPS
%BK
MEASURE
CAL PPS
MEAS
CAL %BK
POWER ON
OFF
LINE
310
%BK
DIRECT
NORTHEAST ELECTRONICS
CORPORATION
CONCORD, N.H., U.S.A.
MODEL TTS-38BDS-8

FIG. 1

VU-DB
FILTER
HIGH PASS
C MSG
3KC
15KC
MON
310
CAL
PPS
CAL
% BK
DBRN -VU-DBM
INPUT
N-GND
900Ω
TERM
BRDG
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600Ω
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-VU-DBM
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PPS
MEAS
% BK
CAL % BK
POWER
ON
OFF
LINE
310
% BK
DIRECT
MODEL TTS-3BBDS-9
NORTHEAST ELECTRONICS
CORPORATION
CONCORD, N.H., U.S.A.

FIG. 1A

VU DB
FILTER
HIGH PASS
3KC
C MSG
15KC
DBRN —VU—DBM
INPUT
N-GND
TERM
BRDG
900Ω
600Ω
MON
310
CAL
PPS
CAL
%BK
NORTHEAST ELECTRONICS CORP
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PPS
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CAL %BK
POWER ON
OFF
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310
%BK
DIRECT
NORTHEAST ELECTRONICS
CORPORATION
CONCORD, N.H., U.S.A.
MODEL TTS-38BS

FIG. 1B

MODEL TTS 38BS, TTS 38BDS-8, TTS 38BDS-9

NOISE, LEVEL, VU AND PULSE MEASURING SET

Operating Instructions

1.0 GENERAL

1.01 The Models TTS 38BS and TTS 38BDS are designed for use on a local test board to measure transmission levels, noise and VU. In addition, the % break and speed of dry loop pulses can be measured. The TTS 38BS, TTS 38BDS-8 and TTS 38BDS-9 differ only in mechanical design. The TTS 38BS is designed for mounting on a swivel "U" bracket which mounts on top or on the front panel of the test board. The TTS 38BDS-8 is designed to fit in the well vacated by a Wheatstone bridge on local test boards. The TTS 38BDS-9 is designed to fit in the well vacated by the card file on the local test board. Front panel diagrams of the three sets are shown in Figures 1, 1A and 1B.

1.02 The sets are equipped with two rugged 4 1/2" meters; one for measuring AC signals and the other for the % break and speed of DC loop signalling.

1.03 The input to the sets is accessed by a LINE jack, a % BK CIRECT jack or, through a plug and socket located on the side of the mounting box.

1.04 Two key switches, FUNCTION and MEASURE, select whether level or pulse measuring checks are to be made.

1.05 The DBRN-VU-DBM measurement sections of the sets are designed to measure a wide range of transmission levels, VU, and noise. They have sensitivity of -80 dbm and 0 dbrn, at 0 db and 0 dbrn on the meter scales respectively. Switchable filters are provided internally to either attenuate the low frequency band around 60 cycles and its lower order harmonics, or to attenuate frequencies above the voice band; a filter which provides C-message weighting is also included. It is possible to determine if high or low frequency noise is being measured. A measurement is made with the 15KC filter connected and then one is made with the HIGH PASS filter. If the reading taken with the HIGH PASS filter is lower than that taken in the 15 KC position of the FILTER switch, then the noise is primarily low frequency in nature as the HIGH PASS filter attenuates frequencies below 700 cps.

1.06 The sensitivity of the set can be varied from -80 dbm to +20 dbm in 1 db and 10 db steps by means of two attenuators; these attenuators are also calibrated in dbrn from 0 to 100 dbrn in blue numbers for easy identification. Circuits of either 600 or 900 ohms balanced or unbalanced, can be measured in either a terminated or a bridging condition. Noise to ground can be measured with a 40 db loss; a longitudinal drain is supplied.

1.07 A MON jack provides an AC output which may be used to drive an impulse noise measuring set, a telephone headset to determine the nature of the signal, or to drive external circuits, thereby using the sets as a variable, high gain amplifier. An overall schematic diagram of the DBRN-VU-DBM measurement section is shown in Fig. 2.

1.08 The pulse measuring sections of the sets is designed to measure the % break and speed of "dry" loop type pulses. The meter has two scales - one for measuring % break and the other for pulse speed measurements.

1.09 The % break measuring section is designed to measure the % break of dry type loop pulses either direct into the high impedance meter circuit or through a low impedance "A" type repeating relay.

1.10 The pulse speed measuring circuit is designed to measure pulse speeds from 4 to 20 pps. An overall schematic of the pulse measuring section is shown in Fig. 2.

Space and Power Requirements

1.11 The TTS 38 series is operated from a filtered 48 volt central office battery normally called "talk battery supply". A diode is provided to protect the internal circuits against damage in the event the wrong polarity of 48 volts is inadvertently applied.

1.12 Current Drain: 30 ma Noise-Level-VU Section
100 ma Pulse Measuring Section

1.13 Dimensions:

TTS 38BS - 8"w x 14"h x 6"d

TTS 38BDS-8 - 8 1/2" x 12 3/4" Cutout required.
Height of back of unit above key shelf is 1 5/8".

TTS 38BDS-9 - 9 3/4" x 12 3/4" cutout required.
Height of back of unit above key shelf is 1 5/8".

2.0 PERFORMANCE AND SPECIFICATIONS

A. NOISE-LEVEL & VU SECTION

2.01 Meter - A 4 1/2" meter with three scales is provided as follows:

a. VU-DB scale calibrated in black divisions and numbers from +3 to -15 db. Between +3 and -3 the scale is calibrated on 0.2 db divisions. 0.5 db divisions are used between -3 and -10 and 1 db divisions and are used between -10 and -15.

b. DBRN scale calibrated in black divisions and blue numbers from 13 to -5 dbrn. Between 13 and 7 the scale is calibrated in 0.2 db divisions. 0.5 db divisions are used between 7 and 0 and 1 db divisions are used between 0 and -5.

c. A VU quality scale is marked in three colors:

Green between 0 and +3 db
Yellow between -6 and 0 db
Red between -15 and -6 db

2.02 Range of Measurements

a. Level Measurements: +23 dbm to -95 dbm

b. Noise Measurements: 113 dbrn to -5 dbrn

c. Noise to Ground Measurements: 113 dbrn to -5 dbrn

2.03 Input Impedances

Balanced input transformer:

a. Terminated: 600 or 900 ohms, ±5% with a phase angle of less than 5^{o} when hold coil is out.

b. Bridging: 12,000 ohms on 600 ohm circuit

15,000 ohms on 900 ohm circuit

c. Longitudinal Drain: Across the line - 85,000 ohms
To ground - 100,000 ohms

2.04 Frequency Response

For designated positions of FILTER switch - variations from 1000 cps. See Figures 8 and 9.

C-MSG:	-3 db at 650 or 3000 cps -20 db at 250 and 4400 cps -40 db at 100 and 6000 cps
HIGH PASS:	-45 db at 60 cps -20 db at 180 cps -3 db at 500 cps
3 KC:	±0.2 db from 100 cps to 1500 cps -3 db at 3000 cps with 18 db per octave slope beyond 3 KC
15 KC:	±0.2 db from 100 cps to 5000 cps -3.0 db at 15 KC with 18 db per octave slope beyond 15 KC

2.05 Monitor Output

a. Output impedance: 600 ohms

b. Output level: -10 dbm when meter reads 0 db

2.06 Stability of Calibration

Variation with temperature: the calibration will stay within 0.1 db of the reading at 70°F for a temperature up to 100°F and down to 35°F, and within 0.25 db up to 125°F.

B. PULSE MEASURING SECTION

2.07 Meter - 4 1/2" meter with 2 scales is provided as follows:

a. % break scale calibrated from 0% to 100% break in 1% divisions.

b. Pulses per second scale calibrated from 0 to 25 pulses per second in 1 pulse divisions.

2.08 Range of Measurements

a. % break measuring circuit: from 0 to 100% break on dry loop pulses either direct into the high impedance meter circuit or through a low impedance (dual 200 ohm winding) "A" type repeater relay. Sufficient damping is provided to allow measurements as close 1% at 10 pulses per second.

b. PPS measuring circuit: dry loop pulses from 4 to 20 PPS can be measured accurately to within 1 PPS. Pulse speed measurements from 0 to 25 PPS can be made at reduced accuracies.

3.0 CIRCUIT DESCRIPTION

A. NOISE-LEVEL & VU SECTION

Schematic Diagram

3.01 The schematic diagram of the Noise-Level and VU Section is shown in Figure 2.

3.02 The gain is obtained from three amplifiers. Each amplifier is enclosed with a large amount of negative feedback to insure gain stability. The inherent noise level is at least -100 dbm and approaches -120 dbm when the C-message filter is used. The circuit can be divided into the following basic elements:

a. Input Circuit
b. 10 db Step Attenuator
c. Amplifier 1
d. Filter Switching Network
e. 1 db Step Attenuator
f. Amplifier 2
g. Amplifier 3
h. Metering Circuit
i. Monitoring Circuits
j. Power Section

3.03 Input Circuit

The input line connections are made to a balanced transformer with DC blocking capable of withstanding 50 volts DC of either polarity. Terminating resistors for 600 and 900 ohm input impedances can be switched directly across the input line and the DC blocking is still maintained. These resistors are switched at the equal potential or center-tapped point to maintain balance. The input circuit is balanced at least 80 db at 60 cps, 70 db at 1000 cps, and better than 60 db up to 10 KC.

3.04 A longitudinal drain, whose center tap is connected to ground through a resistor, is supplied.

3.05 The transformer has a 1:1 ratio. Since the secondary of this is loaded by a high impedance, the primary of the transformer also looks like a high impedance. This reflected impedance is seen in the bridging positions of the INPUT switch. It is nominally 17,000 ohms for 600 ohm circuits and 15,000 ohms for 900 ohm circuits; the bridging losses will be less than 0.2 db for frequencies down to approximately 100 cycles.

3.06 10 db Step Attenuator

This is a three-section attenuator which is the main sensitivity adjustment of the set. 30 db is available in one section and is merely a tapped voltage divider. Two other sections each having 30 db loss can be switched ahead of this. For the first 30 db of loss, the tapped voltage divider only is used. For 40 db of loss, which corresponds to the -30 db position of the SENS control, a single 30 db section is placed ahead of the step voltage divider and 10 db of loss is brought into the output section. Thus the stepped divider is used for the 10 db steps and the other two sections are brought in as necessary to extend the range of these 10 db steps. 1% resistors are used which assures an attenuator accuracy better than ±0.15 db. Normally the accuracy is better than this, particularly at the higher sensitivities.

3.07 Amplifier 1

Amp 1 is basically a two-stage voltage amplifier with negative feedback. An emitter follower is incorporated in the output stage since this amplifier drives the filter sections.

3.08 Q102, Q103, and Q104 comprise the amplifying section. Q102 is a conventional common emitter whose bias is obtained from the collector for DC stabilization. Q103 is also operated in the common emitter but since this is also an NPN, bias conditions and polarities are reversed. Q104 operates as a common collector or emitter follower to isolate the filter impedances from the collector of Q103 to which it is DC connected. The emitter current of Q104, both AC and DC is eventually returned to a resistor which is common to the emitter of Q102; this comprises negative feedback. For the circuit shown, approximately 30 db of feedback is achieved and is effective over the entire band of frequencies. The two diodes in the emitter of Q104 are a battery compensating network. If the battery voltage decreases, the emitter current of Q104 will also decrease. This raises the impedance of these two diodes which decreases the negative feedback by a slight amount, thereby keeping the overall gain of the set relatively independent of the battery voltage. The emitter of Q104 supplies an output through an RC network which keeps DC and voltage transients produced by switching from subsequent stages. The nominal output impedance of the amplifier is in the order of 5 ohms, due to its emitter follow type output and heavy amounts of feedback. A series resistance is used to bring this up to a value to match the filter characteristics which is basically 600 ohms.

3.09 Filter Switching-Network

This selects the proper components to produce the responses shown on Figures 8 and 9.

3.10 1 db Step Attenuator

This is a conventional stepped voltage divider which presents a 600 ohm impedance to the filter and is terminated by the high impedance of Amp 2. One percent resistors are used which assures an accuracy better than ±0.15 db. Normally the accuracy is better than this, particularly at the higher sensitivities.

3.11 Amplifier 2

This is a three-stage amplifier incorporating negative feedback consisting of Q201, Q202, and Q203. Overall feedback is applied from the emitter of Q203 and to the emitter of Q201 while the output is taken from the collector of Q203. Q201 is a conventional common emitter amplifier with collector to base bias. Q202 is also a common emitter configuration but since this is an NPN, the emitter is returned to battery while the collector is returned to ground. The output of Q202 which appears at its collector is direct coupled to the base of Q203. This is also of the common emitter configuration. The emitter Q203 contains a large amount of DC resistance to give the proper amount of current when its base is connected to the collector of Q202. Most of this resistance is by-passed by C203 so that degenerations at signal frequencies will not occur at this point. The unbypassed part of the emitter resistance is R209 which is common to the emitter of Q201. This provides overall loop feedback which stabilizes the gain of the entire amplifier.

3.12 Amplifier 3

Amplifier 3 consists of Q301 and Q302. Both are operated as common emitters with bias dervied from the collector for DC stabilization. The output of Q302 is applied to the diode bridge which is returned to the emitter of Q301 and thus supplied negative feedback. The operation of such a network can be best described on a half cycle basis. When the signal at the collector of Q302 is a negative half cycle, CR302 will not conduct, due to its polarity connection. CR301 will conduct. The signal, however, cannot go through CR305. It can go through the meter and through CR304 back to the emitter of Q302. Note that wave current is from right to left through the meter.

3.13 When the collector of Q109 goes positive, similar reasoning will show that the path of conduction will be through CR302, the meter, CR305 back to the emitter of Q302. Note that on this half cycle, the meter also conducts from right to left. Thus the meter has a pulsating or full wave type current. The ballistics of the meter will ignore the peaks and respond to the average value of DC. The meter is calibrated so that this average value reads in RMS value. The characteristics of such a circuit linearize the resistances of the diodes. For instance, as the resistance of the diodes increase, either due to temperature changes or to decreased meter current, the feedback is automatically adjusted so that the meter current is a linear function

of the input voltage. This is true for wide ranges of temperature and also true for greatly mismatched diodes, thus the circuit is relatively uncritical either to component values or diode voltage-current relationships.

3.14 The use of the diode bridge in the feedback loop rpoduces two results. The bridge is loading the output of Q302; since it is a non-linear bridge, it can be expected that the waveform at Q302 will be distorted. This is true, and the waveshape appears as a flattened sine wave with very sharp edges around the center of the curve. The edges are produced by the fact that for a fraction of a volt on either side of zero, the diodes are not conducting and unload the collector circuit. The flattening is a result of the fact that the diode resistance goes down as the voltage goes up. It therefore, tends to flatten out the peaks of the sine-wave. The feedback mechanism produces a linear current through the diodes. The two half cycles of current are recombined at the emitter of Q108 to form a perfect sine wave.

3.15 Metering Circuit

The meter measures the level applied to the line terminals of the set and under this condition, it is applied to the diode bridge of Amplifier 3.

3.16 The ballistics of the meter are similar to those of a VU meter.

3.17 Monitoring Circuit

The monitor circuit consists of Q303 which samples part of the signal available of Amplifier 3, amplifies it and provides a given source of impedance available to the MON jack. The signal which this amplifier samples is at the emitter of Q301 in Amplifier 3. This is a low impedance point, a sine wave, and is still a direct function of the signal appearing at the LINE jack. The input impedance of the monitor amplifier, Q303, is high enough so that it does not shunt the emitter resistance of Q301 and therefore it does not materially influence the amount of feedback or the value of the gain of either Amplifier 3 or the entire set. The signal available at the MON jack is DC blocked so that a DC resistance can be inserted between the tip and ground of the jack. This DC blocking is done by an electrolytic which means that if any DC voltage should be applied to the tip of the MON jack, it should not exceed 9 volts negative or 12 volts positive.

3.18 The frequency response of the monitoring circuit is -3 db at 100 cycles and 15 KC for the flat 15 KC position. For other filter positions, the response at the monitoring jack is identical with the response to the meter. Signal and noise output at this jack will always be better than 30 db for meter readings of at least -3 dbm. The output level is -10 dbm when the meter reads 0 dbm.

3.19 Power Section

For an amplifier with this much gain and with such a low frequency response, it is necessary to insure that there is no impedance in common with the amplifier supply. Since certain areas of these amplifiers have bandwidths which extend down to 1 cycle, ordinary RC coupling is inadequate except with extremely large values of capacitance. The decoupling in this set may appear slightly unconventional in that Amplifier 1 and Amplifier 2 are decoupled from the battery supply by a transistor, Q1. See Figure 6. Essentially this transistor is operated as a series device although strictly speaking, it can be considered as an emitter follower. It operates with sufficient base bias to insure saturation and very little collector to emitter voltage drop, and with a capacitor, C2, from base to ground. The base is held relatively fixed by this capacitance and the emitter must follow the base. The effect of such a circuit is the same as a conventional RC decoupling network except that the RC produce is effectively increased by the beta of the transistor. In other words, we get the same amount of decoupling with 100 mfd as we would with 5000 mf in conventional RC decoupling.

3.20 Amplifier 3 is supplied through a conventional RC decoupling, the chief function of which is to keep the battery impedance relatively constant.

3.21 When 48 volts of the proper polarity is applied to the set, CR1 will conduct and CR2, a zener diode, will conduct in the reverse direction and maintain a constant voltage. R10 limits the amount of current through the zener diode to a proper value. The use of the zener and the series transistor filter produced sufficient filtering so that the proper signal to noise will be obtained provided the noise on the station battery does not exceed 1 volt peak-to-peak at 10 cycles or higher.

B. PULSE MEASURING SECTION

3.22 A schematic diagram of the PULSE MEASURING SECTION of the unit is shown in Figure 2.

3.23 The % break measuring section provides a means of measuring the % break of "dry loop" pulses. The FUNCTION key switch is used to set up the measuring circuit for operation on loop pulsing. The MEASURE key switch is used to set up the meter circuit for calibration or measurements. The circuit under test may be connected directly to the meter circuit, through the % BK DIRECT jack, or through an "A" type repeating relay using the LINE jack.

3.24 The measuring circuit includes a 4 1/2" meter with a 1 ma movement. A % BREAK scale calibrated from 0 to 100% in 1% divisions is used to facilitate reading % break. The R-C time constants of the meter circuit have been designed to permit proper reading of the % break when the digit "0" is dialed on an

external dial. This damping is also sufficient to keep the angular vibration of the meter pointer to within approximately ±1 division on the meter scale when a pulse rate of 10 pps is measured.

3.25 A calibration control CAL % BREAK in series with the meter permits setting an accurate full scale reading (i.e., 0% break) for battery voltages from approximately 40 to 55 volts.

3.26 The functions which can be established are as follows:

a. CAL % BRK - connects meter circuit to battery and ground permitting adjustment of the CAL % BREAK control for an accurate full scale reading.

b. % BRK DIRECT - the ring of the % BRK DIRECT jack is connected to ground and the tip is connected to the positive side of the meter. The negative side of the meter is connected to 48V.

c. % BRK-THRU RLY - the tip of the LINE jack is connected to the upper winding of the "A" relay to ground, and the ring is connected to the lower winding to battery. The meter circuit reads the % break of the "A" relay contacts.

3.27 The dial pulse speed measuring circuit provides a means of measuring dial speed. The FUNCTION switch is used to set up the speed measuring circuit. The MEASURE key switch provides a calibrate position to enable calibration of the set to compensate for variations in battery voltage. The LINE jack provides a connection for the line under test to the TTS 38.

3.28 The measuring circuit includes a 4 1/2" meter with a 1 ma movement. A PPS scale calibrated from 0 to 25 pps in 1 pps divisions is used to facilitate reading pulses per second. Pulses applied to the LINE jack operates relay K1 which in turn charges an integrator circuit with a voltage proportional to speed of the pulses. This voltage is applied across the meter circuit which indicates pulse speed. The response of the meter is fast enough to permit an accurate reading when the digit 9 is dialed on a 10 pps dial.

3.29 A calibration control CAL PPS is provided to permit setting on accurate full scale reading (i.e., 25 pps) for battery voltages from approximately 40 to 55 volts.

3.30 The functions which can be established are as follows:

A CAL PPS - connects meter circuit to battery and ground to permit adjustment of the CAL PPS control for an accurate full scale reading.

PPS - the ring of the LINE jack is connected to ground and the tip of the LINE jack is connected to relay K1.

4.0 CONTROLS, SWITCHES, JACKS and TERMINALS

1- POWER: ON-OFF switch for 48V supply.

2- POWER: Indicator lamp lights when power switch is on

3- LINE 310 Jack: Used when making level, PPS, and % break through "A" relay measurements.

4- % BK DIRECT Jack: Used when making % break through the high impedance meter circuit.

5- MON 310 Jack: Provide an AC output for monitoring.

6- CAL PPS: Adjusts PPS meter for full scale for any supply voltage variations.

7- CAL % BK: Adjusts % BK meter for full scale to compensate for loop resistance or supply voltage variations.

8- FUNCTION key switch: Switches input to the appropriate function - DBRN-VU-DBM, PPS or % BK.

9- MEASURE key switch: Used in conjunction with the FUNCTION key switch to CAL PPS, CAL % BK or to measure DBRN-VU-DBM, PPS, or % BK.

10- INPUT switch: Selects either 600Ω Term - 600Ω Brd. Imp, 900Ω Term - 900Ω Brd. Imp or Noise to Ground.

11- FILTER switch: Selects one of the following filters: C-MSG, HIGH PASS, 3KC or 15KC.

12- 1 DB step attenuator: 0 to -10 dbm and 10 to 0 dbrn in 1 db steps (dbrn markings are in blue).

13- 10 DB step attenuator: +20 to -70 dbm and 90 to 0 dbrn in 10 DB steps (dbrn markings are in blue).

14- PLUG: A 12 pin recessed plug is mounted in the case to provide an access for 48 volts to the set as well as providing input and output signals for remote control by switches in a key shelf.

5.0 CALIBRATION

5.01 DBRN-VU-DBM

No external calibration control is available for calibrating the DBRN-VU-DBM measuring section. Normally no calibration is required as the set is extremely stable and should hold its calibration for a long period of time It may be desirable to make a routine check periodically to determine if there has been a change in calibration.

5.02 The calibration is checked by applying an extremely accurate 0 dbm 1000 cps signal to the line jack and setting both attenuators at 0 dbm. The meter should read 0 db. If it does not, the set should be recalibrated.

5.03 To calibrate the set, remove the set from its case, apply a 0 dbm 1000 cps signal to the line jack and adjust R308 until the meter reads 0 db. R308 is located on the amplifier board as indicated on Fig. 6 of this manual.

5.04 PULSE MEASURING

No permanent calibration can be associated with the % break and pulse speed measuring circuits. The CAL % BREAK control and the CAL PPS control should be used with each circuit under test where variance of loop resistance exists.

5.05 To calibrate the % break circuit for signals to be received on the line through the A relay, place the FUNCTION key switch in the % BK position, place the MEASURE key switch in the CAL % BK position and adjust the CAL % BK control until the % break meter reads 0% break. Move the MEASURE switch to the MEAS position; the set is now calibrated to measure the % break of pulses received at the line jack.

5.06 To calibrate the % break circuit for signals received at the % BK DIRECT jack, place the FUNCTION switch in the % BREAK position and place the MEASURE switch in the MEAS position. Connect the circuit to be tested to the % BK DIRECT jack, establish an OFF HOOK condition on the circuit, and adjust the % BK CAL control for 0% break. The set is now calibrated to make % break measurements of signals received directly in the high impedance metering circuit. No A relay is used in these measurements.

5.07 To calibrate the pulse speed measuring circuit, place the FUNCTION switch in the PPS position, place the MEASURE switch in the CAL PPS position and adjust the CAL PPS control until the PPS meter reads 25 PPS. Move the MEASURE switch to the MEAS position. The set is now calibrated to make pulse speed measurements of signals received at the line jack.

6.0 OPERATION

A. NOISE-LEVEL & VU SECTION

6.01 Level Measurements

1. Turn POWER switch ON.
2. Set INPUT switch to desired impedance.
3. Set FILTER switch to desired filter.
4. Set FUNCTION key to DBRN-VU-DBM.
5. Set MEASURE key to MEAS.
6. Connect circuit to be tested to the LINE jack.
7. Set SENS attenuator switches to obtain a convenient reading on the meter. A more accurate measurement may be obtained if the meter needle falls between the black numerals +3 and -3 DBM.
8. The level is the algebraic sum of the SENS switches reading (WHITE NUMBERS ONLY) and the meter reading (BLACK NUMBERS ONLY). Likewise the SENS switches readings are the algebraic sum of the white numerals.

Example:

SENS Switch	Meter Reading	Level
+7 (WHITE)	+2 (BLACK)	+9
+15 (WHITE)	-3 (BLACK)	+12
0 (WHITE)	-1.6 (BLACK)	-1.6
-10 (WHITE)	+2.4 (BLACK)	-7.6
-15 (WHITE)	-0.6 (BLACK)	-15.6

9. To monitor the tone being measured, insert a 310 plug connected to a telephone headset in the MON jack. (This output jack can be connected to a 600 ohm impedance receiving device with little effect on the meter readings.)

6.02 Noise Measurements

1. Follow Steps 1 through 5 under 6.01 Level Measurements.
2. Set the SENS switches to 85 (blue numbers).
3. Connect circuit to be tested to the LINE jack.
4. Reset SENS switches to obtain a convenient reading on the meter, preferably between 7 dbrn and 13 dbrn (blue numbers only).

5. The noise reading is then the algebraic sum of the SENS switches reading (BLUE NUMBERS ONLY) and the meter reading (BLUE NUMBERS ONLY).

Example:

SENS Switches	Meter Reading	Noise Level
27 (BLUE)	7 (BLUE)	34 DBRN
35 (BLUE)	10 (BLUE)	45 DBRN
22 (BLUE)	12 (BLUE)	34 DBRN

6. To monitor the noise being measured, insert a 310 plug connected to a telephone headset in the MON jack. (This output jack can be connected to a 600 ohm impedance receiving device with little effect on the meter readings.)

NOTE 1: When recording noise measurements, the type of filter should be indicated such as 42 DBRN-C-MSG or 85 dbrn 15 KC flat.

NOTE 2: To make "noise to ground" measurements and set input switch to N-GND.

6.03 VU Measurements

1. Follow steps 1 through 6 under 6.01, Level Measurements.

2. Set SENS switches to white numberals to obtain reference point.

3. Meter needle deflections into the green (0 db to +3 db) and yellow (-6 dbm to 0 db) or red (-15 db to -6 db) arcs may now be noted.

B. % BREAK SECTION

6.04 Before conducting any receiving measurements it is important to calibrate the % break measuring circuits. If this procedure is not followed, the voltage drop in the circuit under test is not taken into consideration and an erroneous reading of the % break may be obtained.

6.05 To calibrate the % break circuit for signals received at the % BK DIRECT jack, place the FUNCTION switch in the % BREAK position and place the MEASURE switch in the MEAS position. Connect the circuit to be tested to the % BK DIRECT jack, establish an OFF HOOK condition on the circuit, and adjust the % BK CAL control for 0% break. The set is now calibrated to make % break measurements of signals received directly in the high impedance metering circuit. No A relay is used in these measurements.

6.06 If measurements are made on circuits which have high inductance or capacitance which may distort the pulse wave shape, % break measurements should be made through the line jack. The circuit utilizes a low impedance A relay.

6.07 To calibrate the % break through the relay measuring circuit, place the FUNCTION switch in the % BK position, place the MEASURE switch in the CAL % BK position and adjust the CAL % BK control until the % break meter reads 0% break. Move the MEASURE switch to the MEAS position. The set is now calibrated to make % break measurements of signals received at the line jack.

C. PULSE SPEED MEASURING SECTION

6.08 Before conducting any receiving measurements it is important to calibrate the pulse speed measuring circuit.

6.09 To calibrate the pulse speed measuring circuit, place the FUNCTION switch in the PPS position, place the MEASURE switch in the CAL PPS position and adjust the CAL PPS control until the PPS meter reads 75 PPS. Move the MEASURE switch to the MEAS position. The set is now calibrated to make pulse speed measurements of signals received at the line jack.

7.0 MAINTENANCE

A. NOISE-LEVEL & VU SECTION

7.01 In the event of a grossly inaccurate or missing reading, the following can be checked.

7.02 POWER SUPPLY - Polarity and voltage should be checked. If the polarity is reversed the unit is inoperative.

7.03 FUNCTION Switch - To be in the proper position

7.04 SENS - To be of sufficient sensitivity to give a reading.

7.05 INPUT - Connected to the jack.

7.06 FILTER - Set to allow the frequency of the input signal to pass.

7.07 Should all connections and settings be proper and no meter reading occurs, the circuitry can be checked. The following checks are made with a 1000 cps signal applied at 0 dbm level.

7.08 Input Circuit - Put SENS in -70 dbm position. Turn POWER OFF. With either a VTVM or oscilloscope (CRO) trace the path of the signal. With the CRO grounded to case, look at pin 7 of the transformer. The signal should be approximately 2 volts peak-to-peak. This should also appear at S7 on the wiper of the second deck from the chassis, and the wiper of the deck farthest from chassis. (If the FUNCTION switch is on 600 either BRIDGING or TERM, the signal at S7 will be slightly less than at T1.) The signal at S7 should also appear at the base of Q2. This is point R on the printed circuit board.

7.09 Amp 1 - (Q102, Q103, Q104) - Set SENS to -40 dbm. The CRO should have a deflection sensitivity of at least 0.1 volt/cm. Place the CRO input at point 0. This is the input of Amp 1. The level here should be approximately 0.2 volts peak-to-peak. If it is, Amp 1 is satisfactory. If there is no output or it is very low, proceed with the next step.

7.10 Amp 1 DC - Measure (20,000 ohms per volt - no less than 10 volts full scale) the collector voltages of Q102 and Q103 are shown on the schematic.

7.11 Filter - If the signal appears normal at point 0, check point T; it should be approximately 0.06 volts peak-to-peak.

7.12 Amp 2 - If the signal is normal to point T, place SENS on 0 dbm and check the level at the collector of Q203; it should be approximately 0.15 volts peak-to-peak. If not, check the DC voltages of Amp 2 as shown on the schematic.

7.13 Amp 3 - If the point in step 7.12 is normal, check, with the CRO, the level at C304. This should be approximately 1.5 volts peak-to-peak and appear flattened. If not, check the DC voltages of Amp 3 as shown on the schematic.

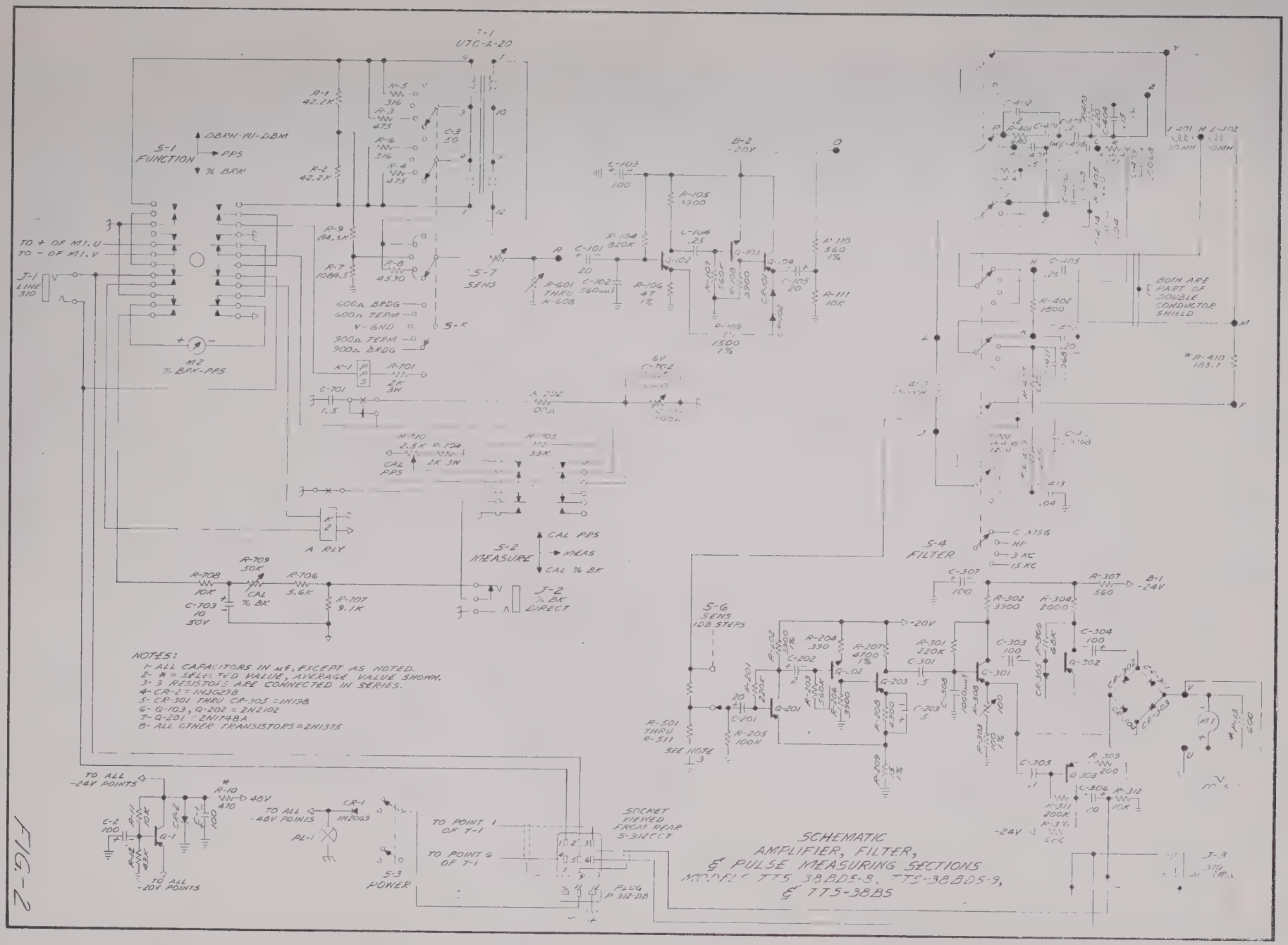
7.14 No external calibration control is available. Normally no calibration is required as the set is extremely stable and should hold its calibration for a long period of time. It may be desirable to make a routine check periodically to determine if there has been any change in calibration.

B. % BREAK SECTION

7.15 Normally no maintenance is required for this section, however, after years of use the "A" relay may require adjustment. The relay should be adjusted to meet the requirements of the similar "A" relay located in the step by step selector switches.

C. SPEED MEASURING SECTION

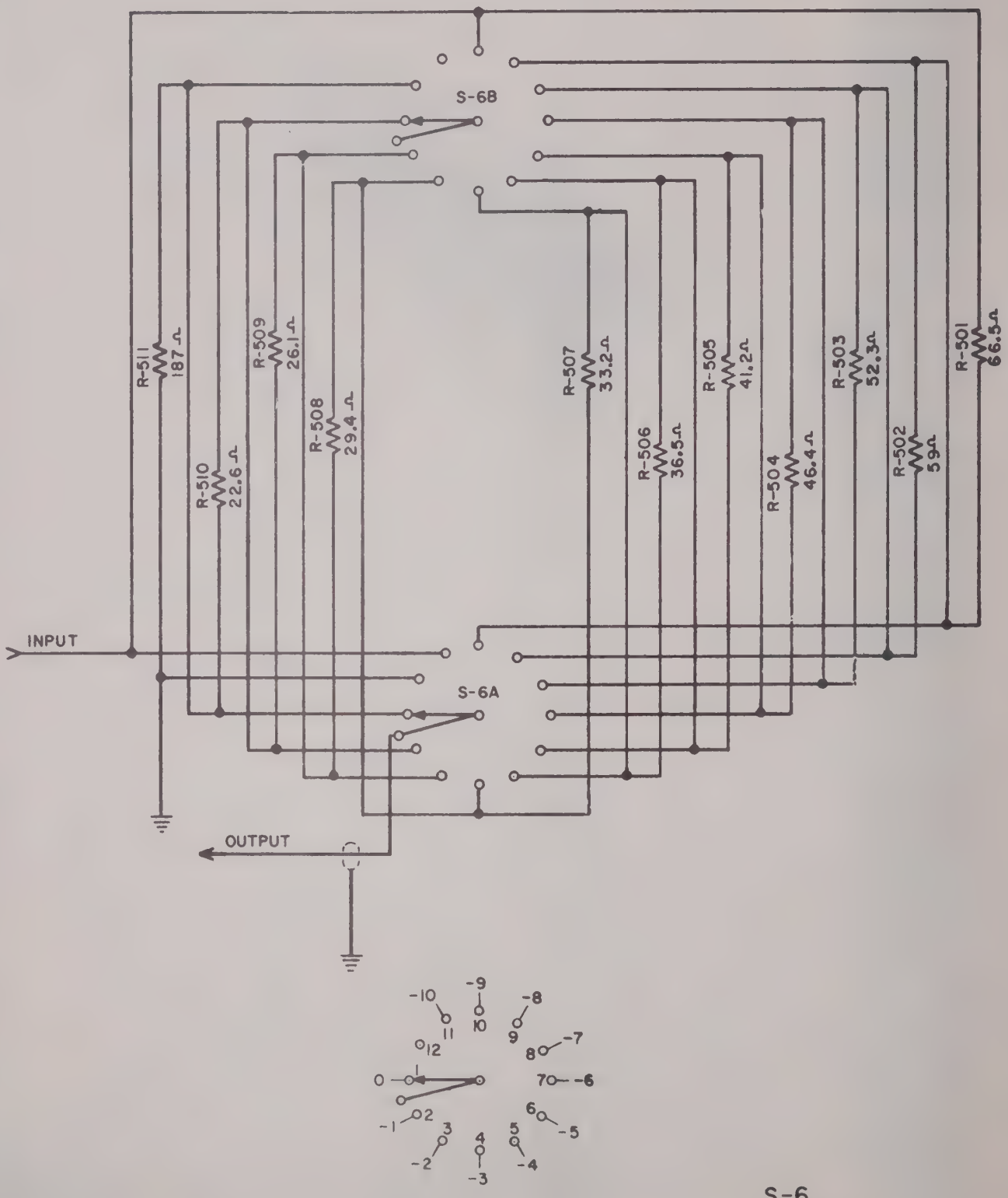
7.16 Normally no maintenance is required for this section, however, it may be desirable to make a routine check periodically to determine if there has been any change in calibration. If recalibration is required, apply a 10 pps signal and adjust R703 until the meter reads 10 pps.



NOTES:
1- ALL CAPACITORS IN μf, ±XCEPT AS NOTED.
2- * = SELECTED VALUE, AVERAGE VALUE SHOWN.
3- 3 RESISTORS ARE CONNECTED IN SERIES.
4- CR-2 = 1N3029B
5- CR-301 THRU CR-305 = 1N198
6- Q-103, Q-202 = 2N2102
7- Q-201 = 2N1748A
8- ALL OTHER TRANSISTORS = 2N1375

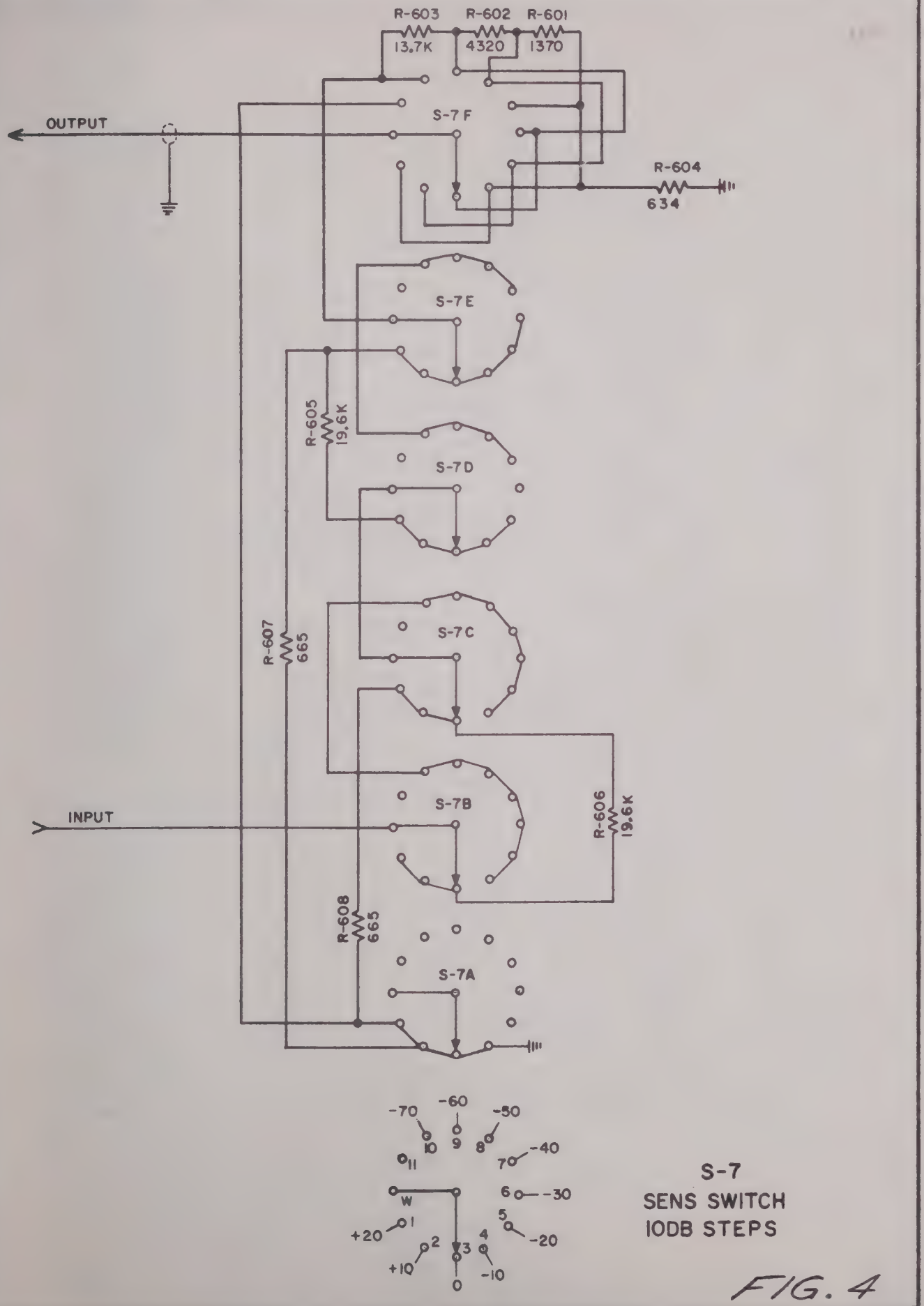
SCHEMATIC
AMPLIFIER, FILTER,
& PULSE MEASURING SECTIONS
MODELS TTS-38BDS-8, TTS-38BDS-9,
& TTS-38BS

FIG-2



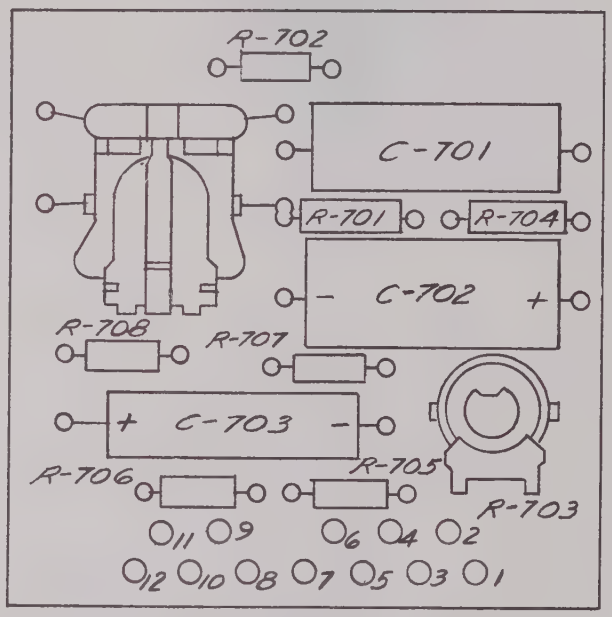
S-6
SENS SWITCH
IDB STEPS

FIG. 3



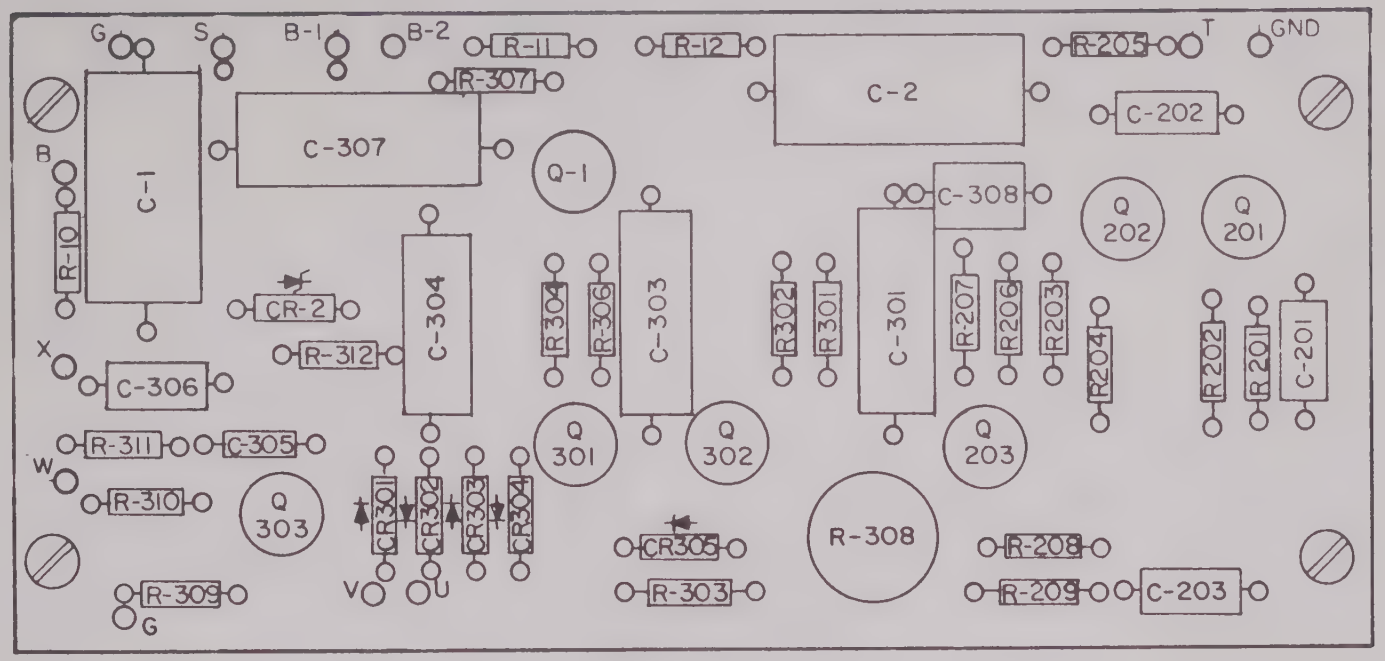
S-7
SENS SWITCH
10DB STEPS

FIG. 4



MODEL TTS-38BDS-8, 9,
TTS-38BS
PULSE MEASURING
COMPONENT LOCATION

FIG. 5



MODEL TTS-38BDS-8, 9,
TTS-38BS
AMP #2
COMPONENT LOCATION

FIG. 6

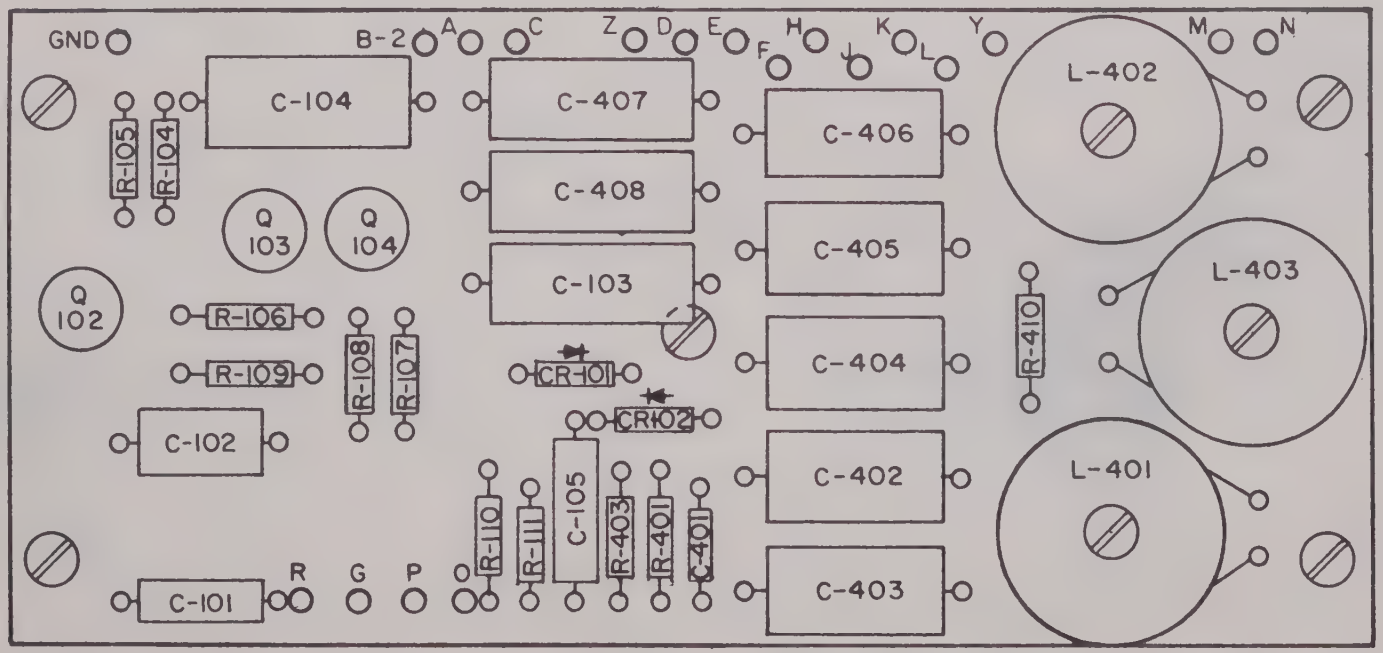
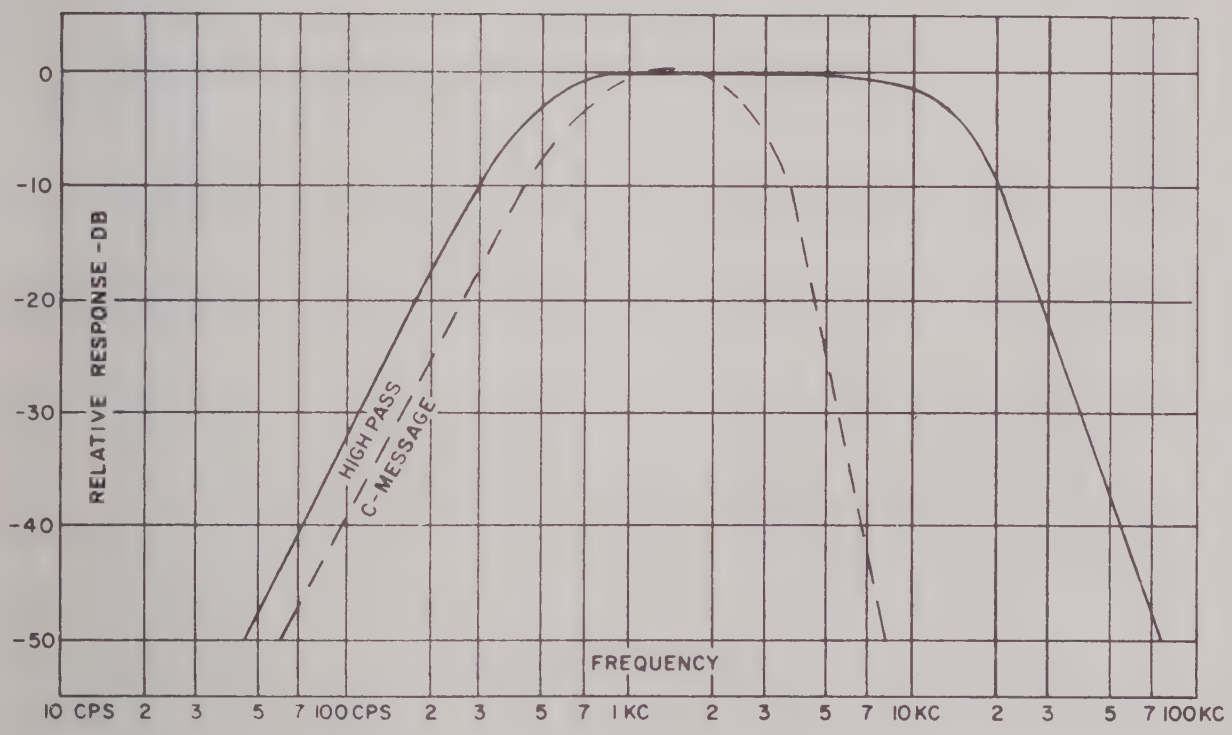


FIG. 7

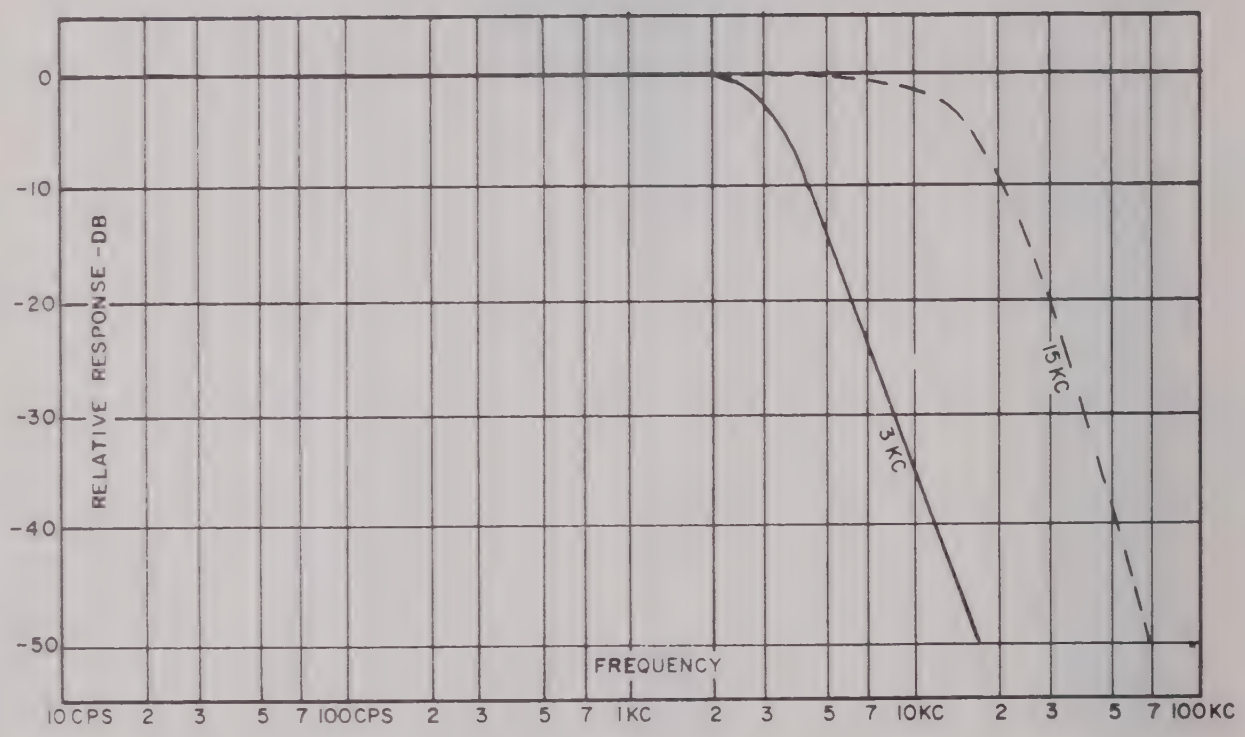
MODEL TTS-38BDS-8, 9,
TTS-38BS
AMP #1
COMPONENT LOCATION



MODEL TTS-38BDS-8, 9,
TTS-38BS

FREQUENCY RESPONSE
WITH
C-MESSAGE AND HIGH PASS FILTERS

FIG. 8



MODEL TTS-38BDS-8, 9,
TTS-38BS

FREQUENCY RESPONSE
WITH
3 KC and 15 KC FILTERS

FIG. 9

MODELS TTS 38BS, TTS 38BDS-8 and TTS 38BDS-9
TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
C1	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	H, APD-127
C2	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	H, APD-127
C3	Capacitor: fixed, non-polarized, 50 mfd, 75 vdc	O, D27359
C101	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	H, APD-046
C102	Capacitor: fixed, mica, 560 mmfd, 400 vdc	C, CM20D561
C103	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	H, APD-095
C104	Capacitor: fixed, paper, 0.25 mfd, 20 vdc	O, ?PS-P25
C105	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	H, APD-046
C201	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	H, APD-046
C202	Capacitor: fixed, electrolytic, 2 mfd, 15 vdc	O, TE-1149
C203	Capacitor: fixed, electrolytic, 5 mfd, 15 vdc	O, TE-1152
C301	Capacitor: fixed, paper, 0.5 mfd, 200 vdc	A, P8292ZN12
C303	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	H, APD-095
C304	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	H, APD-095
C305	Capacitor: fixed, ceramic disc, 0.1 mfd, 75 vdc	E, DDA-104
C306	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	H, APD-046
C307	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	H, APD-127
C308	Capacitor: fixed, mica, 1000 mmfd, 400 vdc	C, CM19E102
C401	Capacitor: fixed, ceramic disc, 1 mfd, 25 vdc	O, 5C13
C402	Capacitor: fixed, paper, 0.20 mfd, 200 vdc	O, 2PS-P20
C403	Capacitor: fixed, paper, 0.20 mfd, 200 vdc	O, 2PS-P20
C404	Capacitor: fixed, paper, 0.15 mfd, 200 vdc	O, 2PS-P15
C405	Capacitor: fixed, paper, 0.25 mfd, 200 vdc	O, 2PS-P25
C406	Capacitor: fixed, paper, 0.20 mfd, 200 vdc	O, 2PS-P20
C407	Capacitor: fixed, paper, 0.5 mfd, 200 vdc	A, P8292ZN12

Circuit Ref	Description	Mfr* & Mfr's Designation
C408	Capacitor: fixed, paper, 0.5 mfd, 200 vdc	A, P8292ZN12
C409	Capacitor: fixed, paper, 0.0068 mfd, 600 vdc	O, 6PS-D68
C410	Capacitor: fixed, paper, 0.0068 mfd, 600 vdc	O, 6PS-D68
C411	Capacitor: fixed, paper, 0.0068 mfd, 600 vdc	O, 6PS-D68
C412	Capacitor: fixed, paper, 0.0068 mfd, 600 vdc	O, 6PS-D68
C413	Capacitor: fixed, paper, 0.04 mfd, 100 vdc	C, IDP-1-403
C414	Capacitor: fixed, paper, 0.04 mfd, 100 vdc	C, IDP-1-403
C701	Capacitor: fixed, paper, 1.5 mfd 50V	A, P1232N870
C702	Capacitor: fixed, electrolytic, 1000 mfd, 6 V	H, APD-122
C703	Capacitor: fixed, electrolytic, 10 mfd, 50 V	O, TVA-1304
R1	Resistor: fixed, metal film, 42,200 ohm ±1% 1/2w	I, CEC-TO
R2	Resistor: fixed, metal film, 42,200 ohm ±1% 1/2w	I, CEC-TO
R3	Resistor: fixed, metal film, 475 ohm, ±1% 1/2w	I, CEC-TO
R4	Resistor: fixed, metal film, 475 ohm, ±1% 1/2w	I, CEC-to
R5	Resistor: fixed, metal film, 316 ohm ±1% 1/2w	I, CEC-TO
R6	Resistor: fixed, metal film, 316 ohm, ±1% 1/2w	I, CEC-TO
R7	Resistor: fixed, metal film, 1084.5 ohm, ±1% 1/2w	I, CEC-TO
R8	Resistor: fixed, metal film, 4530 ohm, ±1% 1/2w	I, CEC-TO
R9	Resistor: fixed, metal film, 84.5 K, ±1% 1/2w	I, CEC-TO
R10	Resistor: fixed, wirewound, 470 ohm, ±5%, 3w	O, 242E4715
R11	Resistor: fixed, composition, 10 K, ±5%, 1/2w	B, EB 1035
R12	Resistor: fixed, composition, 43 K, ±5%, 1/2w	B, EB 4335

Circuit Ref		Description	Mfr* & Mfr's Designation
R13	Resistor:	fixed, copper wire, 600 ohm, ±5% 0.10w	R, CR-16
R104	Resistor:	fixed, composition, 820 K, ±5%, 1/2w	B, EB 8245
R105	Resistor:	fixed, composition, 3.9 K, ±5%, 1/2w	B, EB 3925
R106	Resistor:	fixed, metal film, 47 ohm, ±1%, 1/2w	I, CEC-TO
R107	Resistor:	fixed, composition, 560 K, ±10% 1/2w	B, EB 5641
R108	Resistor:	fixed, composition, 3.9 K, ±5%, 1/2w	B, EB 3925
R109	Resistor:	fixed, metal film, 1.5 K, ±1%, 1/2w	I, CEC-TO
R110	Resistor:	fixed, metal film, 560 ohm, ±1%, 1/2w	I, CEC-TO
R111	Resistor:	fixed, composition, 10 K, ±5%, 1/2w	B, EB 1045
R201	Resistor:	fixed, composition, 220 K, ±5%, 1/2w	B, EB 2245
R202	Resistor:	fixed, metal film, 3.9 K, ±1%, 1/2w	I, CEC-TO
R203	Resistor:	fixed, composition, 560 K, ±10%, 1/2w	B, EB 5641
R204	Resistor:	fixed, composition, 390 ohm, ±5% 1/2w	B, EB 3915
R205	Resistor:	fixed, composition, 100 K ±5%, 1/2w	B, EB 1055
R206	Resistor:	fixed, composition, 3.9 K, ±5%, 1/2w	B, EB 3925
R207	Resistor:	fixed, metal film, 4.7K, ±1%, 1/2w	I, CEC-TO
R208	Resistor:	fixed, composition, 4.3 K, ±5%, 1/2w	B, EB 4325
R209	Resistor:	fixed, metal film, 15 ohm, ±1%, 1/2w	I, CEC-TO
R301	Resistor:	fixed, composition, 220 K, ±5%, 1/2w	B, EB 2245
R302	Resistor:	fixed, composition, 3.9K, ±5%, 1/2w	B, EB 3925
R303	Resistor:	fixed, metal film, 100 ohm, ±1%, 1/2w	I, CEC-TO
R304	Resistor:	fixed, composition, 2 K, ±5%, 1/2w	B, EB 2025
R306	Resistor:	fixed, composition, 68 K, ±5%, 1/2w	B, EB 6835
R307	Resistor:	fixed, composition, 560 ohm, ±10% 1/2w	B, EB 5611
R308	Resistor:	variable, wirewound, 100 ohm	K, 2204

Circuit Ref	Description	Mfr* & Mfr's Designation
R309	Resistor: fixed, composition, 200 ohm, ±5% 1/2w	B, EB 2015
R310	Resistor: fixed, composition, 680 ohm, ±5% 1/2w	B, EB 6815
R311	Resistor: fixed, composition, 200 K, ±5%, 1/2w	B, EB 2045
R312	Resistor: fixed, composition, 10 K, ±5%, 1/2w	B, EB 1035
R401	Resistor: fixed, metal film, 680 ohm, ±1%, 1/2w	I, CEC-TO
R402	Resistor: fixed, metal film, 1800 ohm, ±1% 1/2w	I, CEC-TO
R403	Resistor: fixed, metal film, 620 ohm, ±1%, 1/2w	I, CEC-TO
R404	Resistor: fixed, metal film, 1351 ohm, ±1% 1/2w	I, CEC-TO
R405	Resistor: fixed, metal film, 620 ohm, ±1%, 1/2w	I, CEC-TO
R406	Resistor: fixed, metal film, 620 ohm, ±1%, 1/2w	I, CEC-TO
R407	Resistor: fixed, metal film, 620 ohm, ±1%, 1/2w	I, CEC-TO
R408	Resistor: fixed, metal film, 1200 ohm, ±1% 1/2w	I, CEC-TO
R409	Resistor: fixed, metal film, 1200 ohm, ±1% 1/2w	I, CEC-TO
R410	Resistor: fixed, metal film, 183.7 ohm, ±1% 1/2w	I, CEC-TO
R501	Resistor: fixed, metal film, 66.5 ohm, ±1% 1/2w	I, CEC-TO
R502	Resistor: fixed, metal film, 59.0 ohm, ±1% 1/2w	I, CEC-TO
R503	Resistor: fixed, metal film, 52.3 ohm, ±1% 1/2w	I, CEC-TO
R504	Resistor: fixed, metal film, 46.4 ohm, ±1% 1/2w	I, CEC-TO
R505	Resistor: fixed, metal film, 41.2 ohm, ±1%	I, CEC-TO
R506	Resistor: fixed, metal film, 36.5 ohm, ±1% 1/2w	I, CEC-TO

Circuit Ref	Description	Mfr* & Mfr's Designation
R507	Resistor: fixed, metal film, 33.2 ohm, ±1% 1/2w	I, CEC-TO
R508	Resistor: fixed, metal film, 29.4 ohm, ±1% 1/2w	I, CEC-TO
R509	Resistor: fixed, metal film, 26.1 ohm, ±1% 1/2w	I, CEC-TO
R510	Resistor: fixed, metal film, 22.6 ohm, ±1% 1/2w	I, CEC-TO
R511	Resistor: fixed, metal film, 187 ohm, ±1% 1/2w	I, CEC-TO
R601	Resistor: fixed, metal film, 1370 ohm, ±1% 1/2w	I, CEC-TO
R602	Resistor: fixed, metal film, 4320 ohm, ±1% 1/2w	I, CEC-TO
R603	Resistor: fixed, metal film, 13,700 ohm, ±1% 1/2w	I, CEC-TO
R604	Resistor: fixed, metal film, 634 ohm, ±1% 1/2w	I, CEC-TO
R605	Resistor: fixed, metal film, 19,600 ohm, ±1% 1/2w	I, CEC-TO
R606	Resistor: fixed, metal film, 19,600 ohm, ±1% 1/2w	I, CEC-TO
R607	Resistor: fixed, metal film, 665 ohm, ±1% 1/2w	I, CEC-TO
R608	Resistor: fixed, metal film, 665 ohm, ±1% 1/2w	I, CEC-TO
R701	Resistor: fixed, wirewound, 2 K, ±5%, 3w	O, 242E2025
R702	Resistor: fixed, composition, 100 ohm, ±10% 1/2w	B, EB 1011
R703	Resistor: variable, composition, 500 ohm	X, MTC-4
R704	Resistor: fixed, wirewound, 2 K, ±5%, 3w	O, 242E2025
R705	Resistor: fixed, 33K, ±5%, 1/2w	B, EB 3335
R706	Resistor: fixed, 5.6K, ±5%, 1/2w	B, EB 5625

Circuit Ref	Description	Mfr* & Mfr's Designation
R707	Resistor: fixed, 9.1K, ±5%, 1/2w	B, EB 9125
R708	Resistor: fixed, 10K, ±10%, 1/2w	B, EB 1031
R709	Resistor: variable, 50K, ±10%, 2w	B, Type JU
R710	Potentiometer: 2.5K, ±10%, 2w	B, Type JU
J1	Jack: telephone (LINE)	P, L-12B
J2	Jack: telephone (% BRK DIRECT)	P, 13B
J3	Jack: telephone (MON)	P, L-12B
L401	Inductor: 30 mh	T, EC-030
L402	Inductor: 30 mh	T, EC-030
L403	Inductor: 150 mh	T, ET-150
M1	Meter: special, 0-1 ma	NEC 458
M2	Meter: special, 0-1 ma	NEC 458
S1	Switch: key, (FUNCTION)	W, 173P
S2	Switch: key, (MEASURE)	W, 173N
S3	Switch: toggle, SPST (PWR)	F, 81015-BP
S4	Switch: rotary, 5 position, 8 pole (FILTER)	E, PA-1026
S5	Switch: rotary, 11 position, 5 pole (INPUT)	E, PA-1016
S6	Switch: rotary, 11 position, 2 pole (1 DB ATTEN)	E, PA-1000
S7	Switch: rotary, 11 position, 6 pole, (10 DB ATTEN)	E, PA-1022
T1	Transformer	U, GR815
Q1	Transistor: PNP	S, 2N-1375
Q102	Transistor: PNP	S, 2N-1375
Q103	Transistor: NPN	V, 2N2102
Q104	Transistor: PNP	S, 2N-1375
Q201	Transistor: PNP	O, 2N-1748A
Q202	Transistor: NPN	V, 2N2102

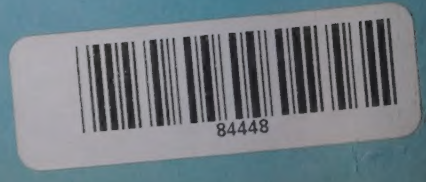
Circuit Ref	Description	Mfr* & Mfr's Designation
Q203	Transistor: PNP	S, 2N-1375
Q301	Transistor: PNP	S, 2N-1375
Q302	Transistor: PNP	S, 2N-1375
Q303	Transistor: PNP	S, 2N-1375
CR1	Diode Rectifier	Q, 1N2069
CR2	Zener Regulator: 24V, ±5%	L, 1N3029B
CR101	Diode Rectifier	Q, 1N198
CR102	Diode Rectifier	Q, 1N198
CR301	Diode Rectifier	Q, 1N198
CR302	Diode Rectifier	Q, 1N198
CR303	Diode Rectifier	Q, 1N198
CR304	Diode Rectifier	Q, 1N198
CR305	Diode Rectifier	Q, 1N198
	Knobs: for S4, S5, S6, S7	J, S648-3LBB
	Knob: for R709, R710	M, 2242
K1	Relay: 2500 ohm	G, RS5D
K2	Relay: "A" Type	D, PR757-E2

*See List of Manufacturers Code Letters for Replaceable Parts Table

LIST OF MANUFACTURERS CODE LETTERS FOR TABLE OF REPLACEABLE PARTS

MODELS TTS 38, TTS 38BDS-8 and TTS 38BDS-9

Code Letter	Manufacturer
A	Aerovox Corporation
B	Allen-Bradley Company
C	Arco Electronics, Inc.
D	Automatic Electric Company
E	Centralab
F	Arrow, Hart and Hegeman
G	Potter Brumfield
H	International Electronic Industries, Inc.
I	International Resistance Company
J	Kurz-Kasch, Inc.
K	The Muter Company
L	Motorola Semiconductor Products, Inc.
M	H.H. Smith
NEC	Northeast Electronics Corporation
O	Sprague Electric Company
P	Switchcraft, Inc.
Q	Sylvania Electric Products, Inc.
R	Tel Labs, Inc.
S	Texas Instruments, Inc.
T	Triad Transformer Corporation
U	United Transformer Company
V	Radio Corporation of America
W	Stromberg-Carlson
X	Mallory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